ORIGINAL ARTICLE

Patient self assessment of pregnancy status in the emergency department

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Objectives: Pregnancy tests are often performed routinely for female emergency department (ED) patients of reproductive age. One major reason is a perception that patients are unreliable in predicting their own pregnancy status. We hypothesised that patients could reliably predict that they were not pregnant.
Methods: The study used a prospective cohort design, in an urban academic ED, from January 19 to May 19, 2004. All patients for whom a pregnancy test was ordered were asked about their sexual history as well as two additional questions: ''Do you think you might be pregnant?'' and ''Is there any chance you could be pregnant?'' Patients with already documented pregnancies were excluded.
Results: A total of 474 patients had pregnancy tests performed that met inclusion criteria. Eleven (2.3%) tests were positive. Among patients who answered no to both questions (337), one test (0.3%) was positive (negative predictive value (NPV) 99.7%, likelihood ratio (LR) 0.13 (95% CI, 0.02 to 0.82)). The other historical factor with a high NPV (100%) was not being sexually active (LR not calculable). All pregnancies occurred in patients with gastrointestinal or genitourinary as the chief complaint: this comprised only 56% of the presentations for which tests were ordered.
Conclusion: Sexual history and self assessment can be used as a highly effective predictor of a patient not being pregnant. Given the risks of missed pregnancy in the ED, and low monetary and time cost of pregnancy tests, frequent testing is still recommended in most instances.

Pregnancy tests for females of reproductive age are often performed routinely in emergency department (ED) evaluations. Reasons for frequent testing range from the potential morbidity and mortality of treating or misdiagnosing a pregnant patient to medico legal concerns. Underlying all these considerations, however, is a perception that patients are unreliable when predicting their own pregnancy status.[1–4]

Prior studies demonstrating the poor reliability of patient history were undertaken in populations where the overall pregnancy rate was very high.[1] With the advent of cheap and accessible home pregnancy testing, the frequency of ED visits where pregnancy is discovered is likely to have declined. We undertook to re-examine the value of patient history and self assessment in predicting pregnancy status in this environment. An increased reliability assigned to patient self assessment could theoretically reduce unnecessary testing, leading to improved efficiency, decreased patient costs, and better overall care.

Our goal was to examine the hypothesis that patients could reliably predict that they were not pregnant. We used the likelihood ratio of patient pregnancy self assessment and sexual history as our primary outcome measure.

METHODS

Study design, setting, and population

The study used a prospective cohort design in an academic, urban, tertiary care, teaching hospital ED with an annual census of 30 000. The patient population is approximately 70% Caucasian, 8% African American, 7% Asian, and 3% Hispanic, with the remaining 12% not coded or unknown. Approximately 46% of patients have private insurance, 35% have publicly funded insurance, and the rest (19%) are uninsured.

Participants in this study included all patients presenting to the ED for whom urine or serum pregnancy tests were ordered during a 4 month period (19 January to 19 May 2004.

Study protocol

Prior to ordering a pregnancy test, all physicians and nurse practitioners were required to fill out a questionnaire with each patient's gynaecologic/sexual history and presenting complaint. The patient's estimation of her pregnancy likelihood was also assessed with two questions: ''Do you think you might be pregnant?'' and ''Is there any chance you could be pregnant.'' The questionnaire was modelled on and nearly identical to the one in Ramoska *et al*'s 1989 study.[1] Ordering clinicians were trained to ask questions in a uniform way.

This study was approved by the home institution's human subjects division with a waiver of consent. Patients were at no time informed of the study or that the questions asked were for research purposes. No tests were ordered other than what would have been otherwise performed during the routine workup of each patient.

Exclusion criteria were a previously documented current pregnancy or an incomplete data sheet that did not document answers to pregnancy likelihood questions.

Methods of measurement

Pregnancy tests were performed by protocol in the hospital's main laboratory. Urine or serum pregnancy test determination was at the discretion of the ordering clinician. The hospital's urine test is manufactured by Mainline Technology, Incorporated (Ann Arbor, Michigan, USA), with a sensitivity to 20 mIU/ml. The serum test used is run on Abbot Laboratories' (Abbott Park, Illinois, USA) AxSYM device, with sensitivity to 3 mIU/ml.

Outcome measures and data analyses

For each question of sexual history and pregnancy likelihood estimation, negative predictive values as well as likelihood ratios for negative and positive pregnancy tests were

Abbreviation: ED, emergency department

calculated. Frequencies of chief complaints for which pregnancies were discovered were also calculated.

Data were entered into a spreadsheet using Excel X for Mac (Redmond, Washington, USA). Statistical analyses were performed using SPSS (Chicago, Illinois, USA).

RESULTS

A total of 527 patients presenting to the ED during the study period had pregnancy tests sent, of which 515 (97.7%) had correctly filled out study sheets. Of this subset, 41 (8.0%) had previously documented pregnancies and were excluded from further study, which left a total of 474.

The mean patient age was 28.4 years (range 16 to 53 years). Age distribution is detailed in Table 1.

Sexual activity was endorsed by 349 (75%) patients; birth control was used by 220 (63%) of that subset. A summary of sexual histories obtained is presented in Table 2.

Overall, there were 11 (2.3%) positive pregnancy tests. Two initially positive urine results, when vigorously refuted by the patients, were subsequently found to be negative by confirmatory serum studies, and ordered as part of the clinician's routine work up during the same visit. These cases were counted as negative tests and are consistent with false positive rates in the literature.[5]

The negative predictive value of a patient saying that she was not sexually active was 100% (95% confidence interval (CI) 96.3 to 100.0). The negative predictive value of a patient stating that there was no chance she could be pregnant was 99.7% (95% CI 98.1 to 100.0); the one patient who had a positive test while denying any chance of being pregnant had a normal and on time last menstrual period but was sexually active and denied using birth control. Negative predictive values and likelihood ratios of each variable are presented in Table 3.

Positive likelihood ratios are presented in Table 4. The most useful question to predict pregnancy was ''Do you think you might be pregnant,'' with a likelihood ratio of 10.5 (95% CI 5.5 to 20.5). The sensitivity of a patient stating she might be pregnant was 54.5% and the specificity was 94.8%; if a patient stated only that there was a chance she could be pregnant, the sensitivity was 90.1% and the specificity was 72.4%.

Chief complaint distributions are presented in Table 5. Among the patients presenting with abdominal or pelvic complaints, eight (3.8%) were pregnant. Patients with a chief complaint other than genitourinary or gastrointestinal made up 196 (42.0%) of the tests ordered, all of which were negative. Of that subset, 59 (30.1%) stated that they did not think they might be but that there was a chance they could be pregnant and 13 (6.6%) answered yes to both questions.

DISCUSSION

A basic tenet of emergency medicine practice is ''Get a pregnancy test, because the reproductive, contraceptive, and menstrual histories of patients in their child bearing years are unreliable.''[3] This message is frequently repeated in emergency medicine training and practice.[6–8] The current study suggests that, in our population, claiming an absence of sexual activity or ''no chance'' of pregnancy was an excellent predictor of a negative pregnancy test; a normal menstrual history or use of birth control was not.

Historic distrust of patient self assessment is based on very few ED studies. Ramoska *et al*'s oft cited 1989 study, with a remarkably high overall pregnancy rate of 33%, found that

Table 1 Age distribution of the study population

Age, years (n)	% of total
16–19 (54)	11.4
20–23 (114)	24.1
24–27 (94)	19.9
28–31 (62)	13.1
32–35 (59)	12.5
36–39 (30)	6.3
40–43 (27)	5.7
44–47 (14)	3.0
48 or older (19)	4.0

One patient did not have an age recorded.

Table 2 Sexual history of the study population

	% of total
Last menstrual period	
On time (n = 361)	84.0
Normal (n = 351)	82.6
Sexually active (n = 349)	75.1
Birth control* (n = 220)	63.0
Birth control type†	
Contraceptive pills (n = 99)	45.0
Condoms (n = 68)	30.9
Depo-Provera (n = 23)	10.5
Tubal ligation/vasectomy (n = 17)	7.7
Other (n = 13)	5.9

*Percentage using birth control is among those who are sexually active.
†Per cent of each birth control type is among those using birth control.
Note: some data sheets had incomplete sexual history information; percentages are of those reporting.

Table 3 Predictive values and likelihood ratios of historical variables for being not pregnant

Historic variable	Negative HCG	NPV	LR-	95% CI
Not sexually active (n = 130)	130	100.0%	*	*
No to ''chance pregnant'' (n = 337)	336	99.7%	0.13	0.02 to 0.82
No to ''might you be''† (n = 444)	439	98.9%	0.48	0.25 to 0.92
Uses birth control (n = 231)	228	96.1%	0.47	0.18 to 1.25
LMP normal (n = 349)	343	96.0%	0.74	0.43 to 1.27
LMP on time (n = 361)	356	94.9%	0.59	0.38 to 1.13

*Likelihood ratio cannot be calculated as there were no positive results for subjects who stated they were not sexually active.
†There were no cases in which the patient stated that she ''might be'' pregnant but that there was ''no chance'' she could be pregnant.
CI, confidence interval; HCG, human chorionotropic gonadotropin; LMP, last menstrual period; LR-, negative likelihood ratio; NPV, negative predictive value.

Table 4 Likelihood ratios of historical variables for being pregnant

	Positive HCG	LR+	95% CI
Yes to ''might be'' (n = 30)	6	10.53	5.51 to 20.47
Yes to ''chance pregnant'' (n = 137)	10	3.23	2.59 to 4.17
LMP not on time (n = 113)	7	2.36	1.36 to 4.11
LMP not normal (n = 125)	5	1.75	0.91 to 3.39
No birth control (n = 242)	8	1.71	1.19 to 2.48
Sexually active (n = 344)	11	1.37	1.30 to 1.45

CI, confidence interval; HCG, human chorionotropic gonadotropin; LMP, last menstrual period; LR+, positive likelihood ratio.

Table 5 Chief complaint distribution for patients receiving pregnancy tests

	Percent of total	Positive HCG tests
Abdominal pain (n = 182)	39.0	4
Urinary complaint (n = 57)	12.2	0
N/V/D (n = 55)	11.8	1
Vaginal bleeding (n = 30)	6.4	4
Chest complaint (n = 30)	6.4	0
Neurological (n = 24)	5.1	0
Syncope/dizziness (n = 16)	3.4	0
Minor trauma (n = 12)	2.6	0
Psychiatric (n = 11)	2.4	0
HEENT (n = 10)	2.1	0
Requesting HCG test (n = 4)	0.9	2
Other (n = 36)	7.7	0
Total (n = 467*)	98.5*	11

*Seven patients did not have chief complaints included in their forms. HCG, human chorionotropic gonadotropin; HEENT, head, eyes, ears, nose, and throat; N/V/D, nausea/vomiting/diarrhoea;

11.5% of women who reported no chance of pregnancy had a positive pregnancy test.[1] It is unclear why the prior study's results differ so dramatically from those presented here. Part of the discrepancy in the overall pregnancy rate can be explained by our exclusion of patients with already documented pregnancies; our rate increases to nearly 10% when these patients are included. Other possible explanations for the higher pregnancy rate and lower accuracy in predicting a positive test include a considerably different hospital population, different pre-test probability criteria for ordering the study, changing cultural mores and attitudes in discussing reproductive issues, and increasing accessibility of home pregnancy testing. At least some impact from this last possibility is suggested by the fact that a concern about potential pregnancy comprised nearly 15% of the prior study's chief complaints whereas it represented less than 1% in the current study.

More recently (1994), in a non-clinical context in which patients knew they were being studied, Stengel *et al* found results more consistent with the current study: a total pregnancy rate of 6.3%, only one of 128 (0.8%) patients who denied any possibility of pregnancy being incorrect, and similar sensitivity and specificity of the question ''is there a chance you could be pregnant;'' patients with a known pregnancy were not included in this study.[9]

If, because of home testing accessibility, better education, or other factors, ED diagnosis of pregnancy is declining, as may be suggested by these sequential studies, the benefit of trying to predict pregnancy from historical factors also decreases. If the pre-test probability of unknown pregnancy in an ED population is only 2.3% (as it was in this study), a patient saying she had no chance of being pregnant decreases that chance to 0.3% using the negative likelihood ratio presented here. It is unclear whether there is a clinical significance to that decrease when the initial risk is so low. In contrast, in the Ramoska *et al* study, a pre-test probability of 33% could conceivably be decreased to 4%, which might have a larger impact on practice.

How then should pregnancy testing decisions be made in the ED? Increased reliance on patient history rather than routine testing to predict pregnancy status has been reported for patients about to undergo surgery.[10 11] A recent article suggested that a pregnancy risk of less than 3% is low enough for its authors to prescribe antibiotics in a primary care setting without testing first.[12] Although there is no clear practice guideline, the emergency medicine literature clearly recommends erring on the side of liberal pregnancy testing.[6–8] Such verification early in an ED evaluation is intuitively attractive. In contrast to primary care encounters where long term relationships may develop, ED evaluations are usually brief and isolated, creating the potential for distrust. Furthermore, use of teratogenic studies and therapies is common, and even in cases where such use is unlikely, the risk of delay when adding a pregnancy test late in an evaluation may outweigh the costs of routine testing. Testing is relatively inexpensive and, when done in parallel with the rest of the exam, does not usually add time to a patient visit.

The present study suggests that in ED populations, historical variables can be quite reliable in predicting pregnancy. Even if the results of this study were found to be widely reproducible, suggesting a consistently high reliability of patient history, would the money saved be worth the risk? The patient cost of the 515 tests ordered in our institution was $19 845. If tests were only ordered for the 137 patients who stated there was a chance of pregnancy, $14 521 would have been saved but one pregnancy would have been missed. Even when the chance of a catastrophic event caused by a missed pregnancy is reasonably low, the extreme cost of such an event would likely justify much iteration of the potential savings described here.

In our study, 29% of pregnancy tests were ordered for chief complaints that were less likely to be pregnancy related or involve teratogenic studies or therapies: $5 755 would have been saved in not testing these patients and no pregnancies would have been missed. The potential for time lost when unforeseen evaluations and therapies become necessary, and the difficulty in predicting such events, makes such limited savings unlikely to be justifiable.

Is there any place for using patient history in pregnancy status determination? If the results here are predictive of the general population, one could envision numerous low risk situations where the trustworthiness of the patient could save time, decrease testing, and/or influence treatment decisions—a potentially teratogenic treatment choice for a simple urinary tract infection diagnosed without testing would be a common example. Whether the benefit would outweigh the limited risk in such situations would have to be determined by further study.

The results from this study also suggest that patient self assessment can be accurate in forecasting a positive pregnancy test: an affirmative response to the question ''might you be pregnant?'' or ''is there a chance you are pregnant?'' had a high likelihood ratio predicting pregnancy. Although presumably pregnancy tests would always be ordered for such patients, it adds further evidence that patient histories can be reliable in predicting pregnancy status. Limitations of this study include its single patient population; further study comprising a larger, more diverse population spanning multiple hospitals would be necessary to generate broadly useful practice recommendations. Additionally, although the patients were unaware of the study, ordering physicians were not blinded, which may have influenced how questions were asked and answers documented; this may have biased the answers toward a more conservative or liberal assessment by the patients and no evaluation of questionnaire uniformity was performed. Furthermore, the extra work of filling out a study form could have dissuaded practitioners from ordering pregnancy tests when they otherwise would have, biasing the population toward patients appearing less reliable or more likely to be pregnant. It is also possible that pregnancy tests were sent without a questionnaire being filled out although every effort was made to avoid this. Urine and serum tests with different sensitivities may have biased the results if certain tests were unconsciously ordered for different populations of patients. Given the frequent ED custom of ordering a pregnancy test on the first sample available (blood or urine), the arbitrary use of tests in this study probably reflects real ED practice.

Perhaps more importantly, using urine pregnancy tests with clinically significant false positive and negative rates as the gold standard on a large fraction of the patients studied could have skewed the results in important ways.

The data presented here suggest that sexual history and self assessment are more reliable in predicting a patient not being pregnant than has previously been reported. We recommend the clinician make an active decision when ordering a pregnancy test, always erring on the side of caution, but giving appropriate credence to patient self assessment of her pregnancy risk when weighing risks and benefits.

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